Terrestrial Salamander Abundance in Successional Forests of Coastal British Columbia

Theodore M. Davis, Department of Biology, University of Victoria, Victoria, British Columbia, Canada, V8W 3N5

Pages 89-90 *in* J.A. Trofymow and A. MacKinnon, editors. Proceedings of a workshop on Structure, Process, and Diversity in Successional Forests of Coastal British Columbia, February 17-19, 1998, Victoria, British Columbia. Northwest Science, Vol. 72 (special issue No. 2).

Acrobat® version prepared and distributed by:

Natural Resources Canada
Canadian Forest Service
Pacific Forestry Centre
506 West Burnside Road
Victoria, British Columbia
V8Z 1M5
Canada

http://www.pfc.cfs.nrcan.gc.ca

Natural Resources Canada | Ressources naturelles Canada
Canadian Forest Service | Service canadien des forêts

Canada

Theodore M. Davis, Department of Biology, University of Victoria, Victoria, British Columbia, Canada, V8W 3N5

Terrestrial Salamander Abundance in Successional Forests of Coastal British Columbia

Understanding patterns of distribution and abundance is fundamental to ecology and conservation biology. These patterns can be influenced by environmental conditions, interspecific interactions, or both. On Vancouver Island, British Columbia, two forest-dwelling plethodontid salamanders, western red-backed salamander (*Plethodon vehiculum*) and clouded salamander (*Aneides ferreus*), are widely sympatric, but differ in the details of their distributions and microhabitat requirements. Abundance among sites is highly variable, and each species seems to be common only where the other species is uncommon. Also, *A. ferreus* , but not *P. vehiculum*, is found on many of the smaller islands adjacent to Vancouver Island. My objectives here are to address some methodological issues concerning estimating abundance of these salamanders, to report estimates of relative abundance and microhabitat use at a variety of sites on Vancouver Island, and to identify some areas of uncertainty with respect to the long-term persistence of these salamander populations.

On Vancouver Island, plethodontid salamanders can be found at the surface throughout most of the year, but disappear during the coldest part of the winter when below-freezing temperatures force them underground or deep inside logs, and during the driest part of the summer when they are subject to desiccation. Peak surface abundance is usually in spring or early summer. Resources such as mates and prey are obtained primarily at the surface, and little or no feeding is thought to take place underground. Thus, their ability to grow and reproduce is directly related to the length of time they spend near the surface. They are opportunistic predators, feeding on small terrestrial invertebrates. Because they are able to allocate a high proportion of their ingested energy to producing new biomass, dense populations can form that are important to other species as either predators or prey.

Making unbiased estimates of the abundance of terrestrial salamanders is complicated by variability in search efficiency resulting from their small size and cryptic coloration, seasonal activity patterns, recent weather conditions, local microhabitat features, species-specific microhabitat use, and individual site-tenacity. Unit-effort searches can result in unacceptable disturbance of natural cover and microhabitats where repeated searches of the same area are needed, or where disturbance of the natural habitat is unacceptable or prohibited. Searches of natural cover among sites that differ in the amount and type of coarse woody debris (CWD) might not be comparable because search efficiency will vary among types of cover, resulting in unequal search effort. Also, search effort may vary among individual searchers or through time with the same individual. Artificial cover objects (ACOs) with species-specific microhabitats can overcome some of these difficulties (Davis 1997). They cause little or no damage to natural cover, attract species that are difficult to sample by other means, provide a standardized sampling unit across sites that differ in structure, and minimize observer bias.

At each of nine sites on eastern Vancouver Island, I established arrays of 0.3 x 2 m ACOs. Each ACO consisted of three boards arranged to create multiple microhabitats (Davis 1996, 1997). In 1992 and 1993, I checked 228 ACOs every other week, but less often in 1994. I also searched natural microhabitats and investigated distribution and abundance with time-constrained searches at 16 additional sites. At the northern sites (49°27' N), *A. ferreus* was more abundant than *P. vehiculum*, but the situation was reversed in the south (48°28' to 48°50' N). I found no differences in site characteristics that would explain this pattern, and determined that competition is unlikely. Salamander abundance was reduced in clearcuts, but there was no difference among old-growth (> 200 years), mature (65-85 years), and immature (25-45 years) stands. This suggests that small-scale local disturbance has no long-term consequences for abundance, but leaves open the question of landscape and metapopulation effects.

The density of *P. vehiculum* was relatively low (surface densities of approximately 0.1 salamanders/m^2 or less) across wide areas of forest habitat with occasional areas of higher densities. In most areas, abundance was closely correlated with the area of ground covered by CWD and moisture, so that in an apparently homogeneous site, abundance varied by a factor of 12 over a distance as little as 50 m. Some local areas had extremely high densities. For example, in Goldstream Provincial Park, surface densities (based on quadrat searches) were as high as 1.8 *P. vehiculum*/m^2, but density varied by a factor of 72 over a distance of 200 m.

Contrary to my results, Dupuis et al. (1995; and equivalently, Dupuis 1997) found that three old-growth stands (330-500+ years) had three to six times more *P. vehiculum* than mature second-growth stands (52-72 years), an effect attributed to moisture differences and to CWD availability. More sampling over a larger number of sites is required to resolve this discrepancy. Other studies found a strong correlation between the abundance of *P. vehiculum* and the presence of talus (Bury et al. 1991, Corn and Bury 1991). Thus, subtle changes in local moisture conditions, the amount and type of CWD, and the presence or absence of talus can affect the density of *P. vehiculum*.

I collected microhabitat data by searching natural cover and by recording microhabitat use under ACOs. Of the *A. ferreus*, 95% were under bark on logs or within logs. In contrast, 67% of the *P. vehiculum* were under CWD on the soil and 20% were within logs. *Aneides ferreus* used logs in an early to mid-stage of decay, and *P. vehiculum*, when under bark on logs or within logs, used logs in a late stage of decay. Under ACOs, 98% of the *A. ferreus* were found between boards, whereas 85% of the *P. vehiculum* were found on the soil under boards. This suggests that logs suitable for *A. ferreus* in one decade may become unsuitable in the next as they pass beyond some optimum decay class. If logs within the same stand are of different ages, the population could persist indefinitely among logs as they reach and pass through a mid-level state of decay. However, in relatively even-age forests that contain uniform types, amounts, and decay classes of CWD, populations of *A. ferreus* may decline. In contrast, the abundance of *P. vehiculum* might be reduced initially, but because they are less dependent on logs of a particular decay class and are usually found on the soil surface under CWD, their population size should recover as canopy closure increases and CWD accumulates.

Acknowledgements

This study was carried out while I held a Natural Sciences and Engineering Research Council (NSERC) Postgraduate Scholarship in 1991-1992 and 1992-1993, and the King-Platt Fellowship, 1993-1994. Additional funding was provided by grants from the Forestry Practices Component of Forestry Canada's Green Plan, and through the British Columbia Ministry of Environment, Lands and Parks, Wildlife Branch. I thank Kristiina Ovaska and an anonymous reviewer for critical comments. This abstract is derived from work done in partial fulfillment of the requirements for a Ph.D. degree from the University of Victoria, Victoria, BC, Canada.

Literature Cited

Bury, R.B., P.S. Corn, and K.B. Aubry. 1991. Regional patterns of terrestrial amphibian communities in Oregon and Washington. *In* L.F. Ruggiero, K.B. Aubry, A.B. Carey, and M.H. Huff (tech. coords.). Wildlife and Vegetation of Unmanaged Douglas-Fir Forests. USDA, For. Serv., Gen. Tech. Rep. PNW-285. Pac. Northw. Res. Sta., Portland, Oregon. Pp. 341-350.

Corn, P.S., and R.B. Bury. 1991. Terrestrial amphibian communities in the Oregon Coast Range. *In* L.F. Ruggiero, K.B. Aubry, A.B. Carey, and M.H. Huff (tech. coords.). Wildlife and Vegetation of Unmanaged Douglas-Fir Forests. USDA, For. Serv., Gen. Tech. Rep. PNW-285. Pac. Northw. Res. Sta., Portland, Oregon. Pp. 305-317.

Davis, T.M. 1996. Distribution, abundance, microhabitat use and interspecific relationships among terrestrial salamanders on Vancouver Island, British Columbia. University of Victoria, Victoria, BC. Ph.D. Dissertation.

———. 1997. Non-disruptive monitoring of terrestrial salamanders with artificial cover objects on southern Vancouver Island, British Columbia. *In* D. M. Green (ed.). Amphibians in decline: Canadian studies of a global problem. Herpetological Conservation 1:161-174.

Dupuis, L.A. 1997. Effects of logging on the terrestrial amphibians of coastal British Columbia. *In* D. M. Green (ed.). Amphibians in decline: Canadian studies of a global problem. Herpetological Conservation 1:185-190.

Dupuis, L.A., J.N. M. Smith, and F. Bunnell. 1995. Relation of terrestrial-breeding amphibian abundance to tree-stand age. Cons. Biol. 9:645-653.